

1 **AUTOMATIC DIAPHRAGM ASSEMBLY WITH A VARIABLE**
2 **APERTURE FOR A LENS**

3 **BACKGROUND OF THE INVENTION**

4 1. Field of the Invention

5 The present invention relates to a diaphragm assembly for a lens, and
6 more particularly to an automatic diaphragm assembly that is driven by a motor
7 to define a variable aperture and is suitable for digital cameras.

8 2. Description of Related Art

9 Diaphragm assemblies in cameras limit the aperture for a lens, which
10 allows an amount of light passing through the aperture to enter the cameras.
11 Taking a great photograph requires precise control of the aperture to control the
12 amount of light entering the cameras. Digital cameras have become popular for
13 nonprofessional users because digital cameras are convenient to use. A digital
14 camera today must be compact and tiny so it can be conveniently carried and
15 slipped into a pocket. Therefore, a diaphragm assembly for a lens in a digital
16 camera needs to be compact, also.

17 A conventional diaphragm assembly in accordance with the prior art is
18 manually operated and uses a rotatable blade that has multiple preset openings
19 with various diameters to define an aperture size for the lens. The openings have
20 unique diameters and are arranged sequentially along a curved line. Each of the
21 openings represents a stop, so-called f-stop, which appears on an aperture
22 adjusting ring on a lens barrel of the camera. A person needs to rotate the
23 aperture adjusting ring to select a desired opening for a correct exposure.

24 Since the quantity of preset openings is restricted, a range of stops to

1 adjust the aperture defined by the diaphragm assembly for the lens is also limited.
2 For high quality pictures, an opening of the aperture should be accurately
3 controlled to allow a correct amount of light to pass through the aperture. The
4 manually operated preset openings cannot be varied to any desired size of
5 aperture. A person may not be able to acquire a proper aperture size to take a
6 well-exposed photograph because only the f-stops appearing on the aperture-
7 adjusting ring can be selected.

8 To overcome the shortcomings, the present invention provides an
9 automatic diaphragm assembly that can continuously precisely adjust a proper
10 size of an aperture for lens to mitigate or obviate the aforementioned problems.

11 SUMMARY OF THE INVENTION

12 The main objective of the invention is to provide an automatic
13 diaphragm assembly for a lens of a digital camera to precisely limit the amount
14 of light entering the camera for a person to take high quality pictures.

15 Another objective of the invention is to provide a modular diaphragm
16 assembly to improve efficiency of assembling cameras and lower manufacturing
17 costs.

18 An automatic diaphragm assembly for a lens of a digital camera includes
19 a body, an actuating device and an aperture adjustment mechanism. The body
20 has a diaphragm chamber with a bottom and a distal through hole defined
21 completely through the bottom. The aperture adjustment mechanism is movably
22 mounted in the diaphragm chamber and includes two reciprocal blades. Each of
23 the reciprocal blades has a V-shaped inward edge that faces the other blade to
24 define an aperture aligned with the distal through hole. The actuating device

1 actuates the reciprocal blades to continuously change the size of the aperture by
2 reciprocally moving the reciprocal blades to close or open the aperture defined
3 by the inward edges. Therefore, the diaphragm assembly is able to continuously
4 adjust the aperture without any stops to provide a proper aperture for a correct
5 exposure.

6 Other objectives, advantages and novel features of the invention will
7 become more apparent from the following detailed description when taken in
8 conjunction with the accompanying drawings.

9 BRIEF DESCRIPTION OF THE DRAWINGS

10 Fig. 1 is an exploded perspective view of an automatic focus lens with a
11 diaphragm assembly in accordance with the present invention;

12 Fig. 2 is an enlarged perspective view of a diaphragm assembly in Fig. 1;

13 Fig. 3 is an enlarged, exploded and perspective view of the diaphragm
14 assembly in Fig.2;

15 Fig. 4 is an enlarged, operational rear plan view of the diaphragm
16 assembly in Fig. 2 wherein an aperture is defined by two reciprocal blades of the
17 diaphragm assembly; and

18 Fig. 5 is an enlarged, operational rear plan view of the diaphragm
19 assembly in Fig. 2 wherein the aperture is closed.

20 DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

21 With reference to Fig. 1, an automatic diaphragm assembly (10) in
22 accordance with the present invention is mounted in a lens mount (20) of a
23 digital camera (not shown). The lens mount (20) has an optical passage (not
24 numbered) to hold multiple lenses (not shown) and a diaphragm slot (21). The

1 diaphragm slot (21) is longitudinally defined in the lens mount (20) to receive a
2 portion of the diaphragm assembly (10).

3 With further reference to Figs. 2 and 3, the diaphragm assembly (10)
4 comprises a body (11), a motor mount (112), an actuating device (12), an
5 aperture adjustment mechanism (13) and an end cover (14). The body (11) has a
6 front (not numbered), a rear (not numbered), a diaphragm chamber (111), two
7 curved slots (113), a distal through hole (114) and four positioning nubs (115).
8 The diaphragm chamber (111) is defined in the rear and has a bottom (not
9 numbered). The motor mount (112) integrally protrudes from the front of the
10 body (11). The curved slots (113) are defined completely through the bottom of
11 the diaphragm chamber (111) of the body (11) and are aligned with the motor
12 mount (112). The distal through hole (114) is defined completely through the
13 bottom of the diaphragm chamber (111) of the body (11) at a position outside the
14 motor mount (12), is aligned with the optical passage of the lens mount (20) as
15 the body (11) is inserted and held in the diaphragm slot (21) and has a center (not
16 shown). The positioning nubs (115) protrude from the bottom of the diaphragm
17 chamber (111) and are arranged in a rectangular disposition.

18 The actuating device (12) is mounted on the motor mount (112) and
19 comprises a motor (121), an interface (122), a transverse rod (123), two driving
20 studs (124) and a current sensor (125). The motor (121), which may be a step
21 motor, is mounted in the motor mount (112) and has a shaft (not shown) that
22 extends toward the front of the body (11). The interface (122) connects
23 electrically to the motor (121) and has an inner segment (not numbered) that
24 extends into the motor (121). The interface (122) provides a connection for the

1 motor (121) to a servo controller (not shown) so that the servo controller can
2 control the motor (121) to either reverse or forward rotate the shaft of the motor
3 (121). The transverse rod (123) is attached to and rotated by the motor shaft and
4 has two opposite ends (not numbered). The driving studs (124) are respectively
5 attached to the ends of the transverse rod (123), and each of the driving studs
6 (124) has an outside end (not numbered). The outside ends of the driving studs
7 (124) extend respectively into the curved slots (113) so that the driving studs
8 (124) are respectively slidably held in the curved slots (113). The current sensor
9 (125) is mounted on the inner segment of the interface (122) in the motor (121),
10 electrically connects to the interface (122) and comprises a Hall element to sense
11 a value of current of the stator of the motor (121). The sensed value of stator
12 current is returned to the servo controller through the interface (122) to serve as a
13 feedback control system for controlling revolutions of the motor (121).

14 The aperture adjustment mechanism (13) is slidably mounted in the
15 diaphragm chamber (111) of the body (11) and comprises two reciprocal blades
16 (131) and two end caps (132). Each of the reciprocal blades (131) has an
17 overlapping segment (133), a driven arm (134) and multiple elongated
18 transverse slots (137). The overlapping segments (133) are stacked one on top of
19 the other and each of them has an inward edge (135). The inward edge (135) has
20 a V-shaped profile with an open (not numbered) that faces the other to define an
21 aperture (not numbered) aligned with the distal through hole (114) in the body
22 (11). Therefore, a size of the aperture is variable by reciprocally moving the
23 reciprocal blades (131). Pulling the reciprocal blades (131) close to each other
24 makes the inward edges (135) close to each other to reduce the aperture size.

1 Pushing the reciprocal blades (131) away from each other makes the inward
2 edges (135) separate from each other to increase the aperture size. The elongated
3 transverse slots (137) are defined in the overlapping segments (131) and
4 respectively and slidably hold the positioning nubs (115).

5 The driven arms (134) of the reciprocal blades (131) extend toward the
6 curved slots (113) from the overlapping segments (133) and have respectively a
7 longitudinal through hole (136) aligned with one of the curved slots (113). The
8 end caps (132) respectively insert into the longitudinal through holes (136),
9 extend into the curved slots (113) and are respectively attached to the outside
10 ends of the driving studs (124).

11 The end cover (14) covers the diaphragm chamber (111) and has a
12 proximal through hole (141) aligned with the distal through hole (114) in the
13 body (11).

14 With reference to Fig. 4, as the motor (121) rotates the transverse rod
15 (123) in a forward direction, the driving studs (124) respectively move the
16 connected reciprocal blades (131) along the curved slots (113) to separate the
17 inward edges (135) from each other. The separating movements of the reciprocal
18 blades (131) open the aperture to increase the size of the aperture.

19 With reference to Fig. 5, as the motor (121) rotates the transverse rod
20 (123) in a reverse direction, the driving studs (124) respectively move the
21 connected reciprocal blades (131) along the curved slots (113) to move the
22 inward edges (135) toward each other. The closing movements of the reciprocal
23 blades (131) close the aperture to reduce the size of the aperture.

24 Since the angular positions of the transverse rod (123) are precisely

1 controlled by controlling the revolutions of the motor shaft with the servo
2 controller, continuously closing or separating the reciprocal blades (131) to
3 accurately close or open the aperture is easy to achieve. Using the servo
4 controller to precisely control the angular positions of the motor shaft has been
5 well developed in this field and thus is not further discussed here. Consequently,
6 an amount of light in the camera is accurately controlled and kept at an optimum
7 state by changing the size of the aperture surrounded by the inward edge (135) to
8 take the best picture possible.

9 Even though numerous characteristics and advantages of the present
10 invention have been set forth in the foregoing description, together with details
11 of the structure and function of the invention, the disclosure is illustrative only,
12 and changes may be made in detail, especially in matters of shape, size, and
13 arrangement of parts within the scope of the appended claims.